

## CLAIMS

1. A method of planarizing a microelectronic-device substrate assembly, comprising:

depositing a lubricating planarizing solution without abrasive particles onto a polishing pad, the polishing pad having a body, a planarizing surface on the body, and a plurality of abrasive particles fixedly attached to the body at the planarizing surface;

pressing a front face of the substrate assembly against the lubricating planarizing solution and at least a portion of the fixed abrasive particles on the planarizing surface;

moving at least one of the polishing pad or the substrate assembly with respect to the other to impart relative motion therebetween; and

separating regions of the front face from the abrasive particles with a lubricant-additive in the lubricating planarizing solution as the substrate assembly moves relative to the polishing pad.

2. The method of claim 1 wherein depositing the lubricating solution comprises:

adding the lubricant-additive into a non-abrasive solution to form the lubricating planarizing solution; and

disposing the lubricating planarizing solution with the added lubricant-additive onto the polishing pad as the substrate assembly moves relative to the polishing pad.

3. The method of claim 1 wherein depositing the lubricating solution comprises mixing the lubricant-additive into a non-abrasive solution to form a lubricating planarizing solution having a viscosity of at least approximately 10-20 cp and disposing the lubricating planarizing solution onto the polishing pad as the substrate assembly moves relative to the polishing pad.

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4. The method of claim 1 wherein:

the lubricant-additive comprises glycerol; and

depositing the lubricating solution comprises mixing the glycerol into a non-abrasive solution comprising ammonia and water to form a lubricating planarizing solution having a viscosity of at least approximately 4-20 cp, and disposing the lubricating planarizing solution onto the polishing pad as the substrate assembly moves relative to the polishing pad.

5. The method of claim 1 wherein:

the lubricant-additive comprises glycerol; and

depositing the lubricating solution comprises mixing 10% by weight of the glycerol into 90% by weight of a non-abrasive solution comprising ammonia and water to form the lubricating planarizing solution, and disposing the lubricating planarizing solution onto the polishing pad as the substrate assembly moves relative to the polishing pad.

6. The method of claim 1 wherein:

the lubricant-additive comprises polypropylene glycol; and

depositing the lubricating solution comprises mixing the polypropylene glycol into a non-abrasive solution comprising ammonia and water to form a lubricating planarizing solution having a viscosity of at least approximately 4-20 cp, and disposing the lubricating planarizing solution onto the polishing pad as the substrate assembly moves relative to the polishing pad.

7. The method of claim 1 wherein:

the lubricant-additive comprises polypropylene glycol; and

depositing the lubricating solution comprises mixing 5% by weight of the polypropylene glycol into 95% by weight of a non-abrasive solution comprising ammonia and water to form the lubricating planarizing solution, and disposing the

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lubricating planarizing solution onto the polishing pad as the substrate assembly moves relative to the polishing pad.

8. The method of claim 1 wherein:

the lubricant-additive comprises polyethylene glycol; and

depositing the lubricating solution comprises mixing the polyethylene glycol into a non-abrasive solution comprising ammonia and water to form a lubricating planarizing solution having a viscosity of at least approximately 4-20 cp, and disposing the lubricating planarizing solution onto the polishing pad as the substrate assembly moves relative to the polishing pad.

9. The method of claim 1 wherein:

the lubricant-additive comprises polyethylene glycol; and

depositing the lubricating solution comprises mixing 10% by weight of the polyethylene glycol into 90% by weight of a non-abrasive solution comprising ammonia and water to form the lubricating planarizing solution, and disposing the lubricating planarizing solution onto the polishing pad as the substrate assembly moves relative to the polishing pad.

10. The method of claim 1 wherein:

the lubricant-additive comprises polyvinyl alcohol; and

depositing the lubricating solution comprises mixing the polyvinyl alcohol into a non-abrasive solution comprising ammonia and water to form a lubricating planarizing solution having a viscosity of at least approximately 4-100 cp, and disposing the lubricating planarizing solution onto the polishing pad as the substrate assembly moves relative to the polishing pad.

11. The method of claim 1 wherein:

the lubricant-additive comprises polyvinyl alcohol; and

depositing the lubricating solution comprises mixing 10% by weight of the polyvinyl alcohol into 90% by weight of a non-abrasive solution comprising ammonia and water to form the lubricating planarizing solution, and disposing the lubricating planarizing solution onto the polishing pad as the substrate assembly moves relative to the polishing pad.

12. The method of claim 1 wherein:

the lubricant-additive comprises CARBOGEL; and

depositing the lubricating solution comprises mixing the CARBOGEL into a non-abrasive solution comprising ammonia and water to form a lubricating planarizing solution having a viscosity of at least approximately 4-100 cp, and disposing the lubricating planarizing solution onto the polishing pad as the substrate assembly moves relative to the polishing pad.

13. The method of claim 1 wherein:

the lubricant-additive comprises CARBOGEL; and

depositing the lubricating solution comprises mixing 0.25% by weight of the CARBOGEL into 99.75% by weight of a non-abrasive solution comprising ammonia and water to form the lubricating planarizing solution, and disposing the lubricating planarizing solution onto the polishing pad as the substrate assembly moves relative to the polishing pad.

14. The method of claim 1 wherein:

the lubricant-additive comprises POLYOX; and

depositing the lubricating solution comprises mixing the POLYOX into a non-abrasive solution comprising ammonia and water to form a lubricating planarizing solution having a viscosity of at least approximately 4-100 cp, and disposing the lubricating planarizing solution onto the polishing pad as the substrate assembly moves relative to the polishing pad.

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15. The method of claim 1 wherein:

the lubricant-additive comprises POLYOX; and

depositing the lubricating solution comprises mixing 0.25% by weight of the POLYOX into 99.75% by weight of a non-abrasive solution comprising ammonia and water to form the lubricating planarizing solution, and disposing the lubricating planarizing solution onto the polishing pad as the substrate assembly moves relative to the polishing pad.

16. A method of planarizing a microelectronic-device substrate assembly comprising:

depositing a lubricating planarizing solution without abrasive particles onto a polishing pad, the lubricating planarizing solution having a lubricant additive, and the polishing pad having a body, a planarizing surface on the body, and abrasive particles fixedly attached to the body at the planarizing surface;

pressing a front face of the substrate assembly against the planarizing solution on the planarizing surface; and

moving at least one of the polishing pad or the substrate assembly with respect to the other to impart relative motion between the front face of the substrate assembly and the planarizing surface.

17. The method of claim 16 wherein:

the lubricant-additive comprises a viscosity-increasing agent that increases the viscosity of the planarizing solution; and

the method further comprises mixing the viscosity-increasing agent into a non-abrasive solution to form the lubricating planarizing solution prior to depositing the lubricating planarizing solution onto the polishing pad.

18. The method of claim 17 wherein:

the viscosity-increasing agent comprises glycerol; and

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mixing the viscosity-increasing agent into the non-abrasive solution comprises mixing the glycerol into a non-abrasive solution comprising ammonia and water to form a lubricating planarizing solution having a viscosity of at least approximately 4-20 cp.

19. The method of claim 17 wherein:

the viscosity-increasing agent comprises polypropylene glycol; and

mixing the viscosity-increasing agent into the a non-abrasive solution comprises mixing the polypropylene glycol into a non-abrasive solution comprising ammonia and water to form a lubricating planarizing solution having a viscosity of at least approximately 4-20 cp.

20. The method of claim 17 wherein:

the viscosity-increasing agent comprises polyethylene glycol; and

mixing the viscosity-increasing agent into the non-abrasive solution comprises mixing the polyethylene glycol into a non-abrasive solution comprising ammonia and water to form a lubricating planarizing solution having a viscosity of at least approximately 4-20 cp.

21. The method of claim 17 wherein:

the viscosity-increasing agent comprises polyvinyl alcohol; and

mixing the viscosity-increasing agent into the non-abrasive solution comprises mixing the polyvinyl alcohol into a non-abrasive solution comprising ammonia and water to form a lubricating planarizing solution having a viscosity of at least approximately 4-100 cp.

22. The method of claim 17 wherein:

the viscosity-increasing agent comprises CARBOGEL; and

mixing the viscosity-increasing agent into the non-abrasive solution comprises mixing the CARBOGEL into a non-abrasive solution comprising ammonia

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and water to form a lubricating planarizing solution having a viscosity of at least approximately 4-100 cp.

23. The method of claim 17 wherein:

the viscosity-increasing agent comprises POLYOX; and

mixing the viscosity-increasing agent into the non-abrasive solution comprises mixing the POLYOX into a non-abrasive solution comprising ammonia and water to form a lubricating planarizing solution having a viscosity of at least approximately 4-100 cp.

24. A method of planarizing a microelectronic-device substrate assembly comprising:

depositing a non-abrasive solution without abrasive particles onto a polishing pad, the polishing pad having a body, a planarizing surface on the body, and a plurality of abrasive particles fixedly attached to the body at the planarizing surface;

pressing a front face of the substrate assembly against the non-abrasive solution and the planarizing surface;

moving at least one of the polishing pad or the substrate assembly with respect to the other to impart relative motion between the front face of the substrate assembly and the planarizing surface; and

inhibiting the fixed abrasive particles attached to the pad from aggressively abrading the front face and causing defects on the substrate assembly by adding a high viscosity substance to the non-abrasive solution to form a lubricating planarizing solution.

25. The method of claim 24 wherein:

the high viscosity substance comprises glycerol; and

adding a high viscosity substance to the non-abrasive solution comprises mixing the glycerol into a non-abrasive solution comprising ammonia and water to

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form a lubricating planarizing solution having a viscosity of at least approximately 4-20 cp.

26. The method of claim 25 wherein:

the high viscosity substance comprises polypropylene glycol; and

adding a high viscosity substance to the non-abrasive solution comprises mixing the polypropylene glycol into a non-abrasive solution comprising ammonia and water to form a lubricating planarizing solution having a viscosity of at least approximately 4-20 cp.

27. The method of claim 25 wherein:

the high viscosity substance comprises polyethylene glycol; and

adding a high viscosity substance to the non-abrasive solution comprises mixing the polyethylene glycol into a non-abrasive solution comprising ammonia and water to form a lubricating planarizing solution having a viscosity of at least approximately 4-20 cp.

28. The method of claim 24 wherein:

the high viscosity substance comprises polyvinyl alcohol; and

adding a high viscosity substance to the non-abrasive solution comprises mixing the polyvinyl alcohol into a non-abrasive solution comprising ammonia and water to form a lubricating planarizing solution having a viscosity of at least approximately 4-100 cp.

29. The method of claim 24 wherein:

the high viscosity substance comprises CARBOGEL; and

adding a high viscosity substance to the non-abrasive solution comprises mixing the CARBOGEL into a non-abrasive solution comprising ammonia and water to form a lubricating planarizing solution having a viscosity of at least approximately 4-100 cp.



30. The method of claim 24 wherein:

the high viscosity substance comprises POLYOX; and

adding a high viscosity substance to the non-abrasive solution comprises mixing the POLYOX into a non-abrasive solution comprising ammonia and water to form a lubricating planarizing solution having a viscosity of at least approximately 4-100 cp.

31. A method of planarizing a microelectronic-device substrate assembly comprising:

providing a polishing pad having a body, a planarizing surface on the body, and a plurality of abrasive particles fixedly attached to the body at the planarizing surface;

depositing a non-abrasive lubricating planarizing solution without abrasive particles onto the polishing pad having a viscosity of at least approximately 10-20 cp;

pressing a front face of the substrate assembly against the planarizing solution on the planarizing surface; and

moving at least one of the polishing pad or the substrate assembly with respect to the other to impart relative motion between the front face of the substrate assembly and the planarizing surface.

32. The method of claim 31, further comprising:

providing a non-abrasive solution without abrasive particles containing at least water; and

adding a lubricant-additive to the non-abrasive solution to form the non-abrasive lubricating solution without abrasive particles.

33. The method of claim 31, further comprising forming the lubricating planarizing solution by mixing glycerol into a non-abrasive solution

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comprising ammonia and water until the lubricating planarizing solution has a viscosity of at least approximately 4-20 cp.

34. The method of claim 31, further comprising forming the lubricating planarizing solution by mixing polypropylene glycol into a non-abrasive solution comprising ammonia and water until the lubricating planarizing solution has a viscosity of at least approximately 4-20 cp.

35. The method of claim 31, further comprising forming the lubricating planarizing solution by mixing polyethylene glycol into a non-abrasive solution comprising ammonia and water until the lubricating planarizing solution has a viscosity of at least approximately 4-20 cp.

36. The method of claim 31, further comprising forming the lubricating planarizing solution by mixing polyvinyl alcohol into a non-abrasive solution comprising ammonia and water until the lubricating planarizing solution has a viscosity of at least approximately 4-100 cp.

37. The method of claim 31, further comprising forming the lubricating planarizing solution by mixing CARBOGEL into a non-abrasive solution comprising ammonia and water until the lubricating planarizing solution has a viscosity of at least approximately 4-100 cp.

38. The method of claim 31, further comprising forming the lubricating planarizing solution by mixing POLYOX into a non-abrasive solution comprising ammonia and water until the lubricating planarizing solution has a viscosity of at least approximately 4-100 cp.

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39. A method of making a lubricating planarizing solution, comprising:

providing a non-abrasive solution without abrasive particles containing at least water; and

adding a lubricant-additive to the non-abrasive solution to form a non-abrasive lubricating planarizing solution without abrasive particles.

40. The method of claim 39 wherein adding the lubricant-additive to the non-abrasive solution comprising mixing the lubricant additive with the non-abrasive solution until the lubricating planarizing solution has a viscosity of at least approximately 4 cp.

41. The method of claim 39 wherein adding the lubricant-additive to the non-abrasive solution comprising mixing glycerol with a non-abrasive solution comprising water and ammonia to form a lubricating planarizing solution having a viscosity of at least 4 cp.

42. The method of claim 39 wherein adding the lubricant-additive to the non-abrasive solution comprising mixing polypropylene glycol with a non-abrasive solution comprising water and ammonia to form a lubricating planarizing solution having a viscosity of at least 4 cp.

43. The method of claim 39 wherein adding the lubricant-additive to the non-abrasive solution comprising mixing polyethylene glycol with a non-abrasive solution comprising water and ammonia to form a lubricating planarizing solution having a viscosity of at least 4 cp.

44. The method of claim 39 wherein adding the lubricant-additive to the non-abrasive solution comprising mixing polyvinyl alcohol with a non-abrasive

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solution comprising water and ammonia to form a lubricating planarizing solution having a viscosity of at least 10 cp.

45. The method of claim 39 wherein adding the lubricant-additive to the non-abrasive solution comprising mixing CARBOGEL with a non-abrasive solution comprising water and ammonia to form a lubricating planarizing solution having a viscosity of at least 10 cp.

46. The method of claim 39 wherein adding the lubricant-additive to the non-abrasive solution comprising mixing POLYOX with a non-abrasive solution comprising water and ammonia to form a lubricating planarizing solution having a viscosity of at least 10 cp.

47. The method of claim 39 wherein adding the lubricant-additive to the non-abrasive solution comprises mixing approximately 10% by weight of glycerol with approximately 90% by weight of a non-abrasive solution including water and ammonia.

48. The method of claim 39 wherein adding the lubricant-additive to the non-abrasive solution comprises mixing approximately 5% by weight of polypropylene glycol with approximately 95% by weight of a non-abrasive solution including water and ammonia.

49. The method of claim 39 wherein adding the lubricant-additive to the non-abrasive solution comprises mixing approximately 10% by weight of polyethylene glycol with approximately 90% by weight of a non-abrasive solution including water and ammonia.

50. The method of claim 39 wherein adding the lubricant-additive to the non-abrasive solution comprises mixing approximately 10% by weight of

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polyvinyl alcohol with approximately 90% by weight of a non-abrasive solution including water and ammonia.

51. The method of claim 39 wherein adding the lubricant-additive to the non-abrasive solution comprises mixing approximately 0.25% by weight of CARBOGEL with approximately 99.75% by weight of a non-abrasive solution including water and ammonia.

52. The method of claim 39 wherein adding the lubricant-additive to the non-abrasive solution comprises mixing approximately 0.25% by weight of POLYOX with approximately 99.75% by weight of a non-abrasive solution including water and ammonia.

53. A lubricating planarizing solution, comprising:

a non-abrasive solution without abrasive particles, the non-abrasive solution having a viscosity less than 4 cp; and

a lubricant-additive mixed with the non-abrasive solution, the lubricant-additive being a non-abrasive compound having a viscosity greater than approximately 4 cp, wherein the lubricating planarizing solution does not include abrasive particles and has a viscosity at least greater than 4 cp.

54. The lubricating planarizing solution of claim 53 wherein:  
the non-abrasive solution comprises water and ammonia; and  
the lubricant additive comprises glycerol.

55. The lubricating planarizing solution of claim 53 wherein:  
the non-abrasive solution comprises water and ammonia; and  
the lubricant additive comprises polypropylene glycol.

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56. The lubricating planarizing solution of claim 53 wherein:  
the non-abrasive solution comprises water and ammonia; and  
the lubricant additive comprises polyethylene glycol.

57. The lubricating planarizing solution of claim 53 wherein:  
the non-abrasive solution comprises water and ammonia; and  
the lubricant additive comprises polyvinyl alcohol.

58. The lubricating planarizing solution of claim 53 wherein:  
the non-abrasive solution comprises water and ammonia; and  
the lubricant additive comprises CARBOGEL.

59. The lubricating planarizing solution of claim 53 wherein:  
the non-abrasive solution comprises water and ammonia; and  
the lubricant additive comprises POLYOX.

60. A planarizing machine for planarizing microelectronic-device  
substrate assemblies, comprising:

a support table;

a polishing pad on the support table, the polishing pad having a body, a  
planarizing surface on the body, and a plurality of abrasive particles fixedly attached  
to the body at the planarizing surface;

a carrier assembly having a carrier head configured to hold a substrate  
assembly and a drive mechanism attached to the carrier head to move the carrier  
relative to the polishing pad; and

a non-abrasive lubricating planarizing solution without abrasive particles  
on the polishing pad, the lubricating planarizing solution having a viscosity of at least  
approximately 4-100 cp.

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61. A planarizing machine for planarizing microelectronic-device substrate assemblies, comprising:

a support table;

a polishing pad on the support table, the polishing pad having a body, a planarizing surface on the body, and a plurality of abrasive particles fixedly attached to the body at the planarizing surface;

a carrier assembly having a carrier head configured to hold a substrate assembly and a drive mechanism attached to the carrier head to move the carrier relative to the polishing pad;

a first container and a supply of a non-abrasive solution in the first container;

a second container and a supply of a lubricant-additive in the second container; and

a mixing site coupled to the first and second containers, the lubricant-additive being mixed with non-abrasive solution at the mixing site to produce a lubricating planarizing solution, and the mixing site being coupled to a nozzle to dispense the lubricating planarizing solution onto the polishing pad.

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